Cressy (Noah)

DISEASED MEAT

AND ITS

CONSEQUENCES

UPON OUR

HEALTH AND HAPPINESS:

AN

ADDRESS DELIVERED BEFORE THE CONNECTICUT BOARD OF AGRICULTURE,

BY

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The relations of man to the lower order of animals, zoologically considered, which of late has caused so much speculation among philosophers and naturalists, is equally interesting in a physiological and pathological point of view. The skeletal framework and internal organization of the higher mammalia are morphologically identical with that of man, and subserve the same purpose in the animal economy. The blood is similar in chemical composition, contains the same anatomical elements, and is subject to analogous changes in disease. Hence the liability of transmitting to the human system some virulent blood-poison or other morbid products through the medium of the animal food which we consume.

Consequently I believe that there is no subject of more importance to the public health or better calculated to enhance the cause of sanitary science than the practical study of diseased meat. And though many inquiries have been made in this direction and some valuable conclusions reached, yet in this broad field for scientific research the accomplished laborers are few. But the hour has come when the sanitarian and physician, in response to a public demand, must join hands with the veterinary profession to explore certain realms in the causation of disease and also more accurately survey those

boundary lines in pathology which have served as a barrier to the progress of knowledge on this subject, and even now seem to separate the human maladies from those of our food-producing animals.

In fact the very condition of some of our meat supplies already indicates the solution of certain vexed questions on the origin of disease that have been a stumbling block to the medical practitioner. The investigation of this subject, therefore, in all its varied relations to our health and happiness, is a work of vast importance, and one which the age now demands, in behalf of sanitary science. Hence it will require for the achievement of these results not only the united efforts of professional and scientific men but the influence of the public purse and the sanction of our State authorities. Then may we hope to see a thorough system of veterinary inspection established in this country, that shall have full control of the public markets, and examine all suspicious animals before they are allowed to be slaughtered.

NATURE OF DISEASED MEAT.

Few questions in dietetics have been more thoroughly discussed of late years, both by the rich and the poor, than the sanitary condition of animal food; and the difference of opinion on flavor and quality of meat is in a great measure due to habit and education. Our appetites are capricious, and as there is no accounting for taste; what suits one individual may fail to relish with another. But an unpalatable article of meat is not necessarily injurious. In fact, the flesh of animals suffering from a great variety of maladies may be eaten with impunity. Yet the flesh of some, without an apparent symptom of disease during life, may prove fatal when consumed by man. There are certain malignant maladies, also, quite prevalent among some of our domesticated animals, that do not produce an unpleasant flavor in the meat for the palate of the epicure, but which, in the advanced stages, often render the carcass exceedingly hazardous for the butcher to dress.

All meat, therefore, from whatever source or condition of an animal it may come, that would cause sickness, disease, or

death in man if partaken as food, must be regarded in the light of sanitary science as diseased, and consequently unfit for human use in any form. Accordingly an article of meat possessing such qualities must come from an animal afflicted with some form of an infectious malady, the germs of which are contained in the flesh, and are liable to be transmitted.

Hence a disease in which a contagious virus is developed during its course, or a virulent principle generated in the blood, renders the meat from all animals thus affected exceedingly dangerous as an article of food. But meat is not materially affected by the entozoic maladies of animals, unless the parasite in some stage of its existence makes its abode in the flesh and has not been destroyed by cooking.

In accordance with this definition there are but few diseases that absolutely render these animal supplies perilous to human happiness. Prominent among these may be mentioned malignant anthrax, hydrophobia, tuberculosis, small-pox, and two parasitic affections caused by the trichina spiralis, and the measle tape worms. But the other maladies from which our slaughtered animals are liable to have suffered may greatly impoverish the nutritive quality of the meat, and thus render it unpleasant in taste and general appearance, yet if the flesh contains no animal poison or other morbid products no harm can possibly come from its use when served upon our table. And even a diseased article, when thoroughly cooked, may not prove injurious to one whose digestive powers are active.

It is not an easy matter, therefore, in all cases to decide whether meat is possessed of injurious qualities or not without a careful inquiry into the history of the article, or a microscopic inspection. Trichinous pork is an example of this kind; and of the many fatal cases on record, none of the victims ever suspected the meat until a peculiar form of sickness made its appearance, involving a number of individuals who were known to have partaken of the same. This is also true of black-leg veal many times, and of other fine looking specimens of meat that are affected with anthrax poison.

Many varieties of diseased meat, however, are so palpable that even by the dexterity of the butcher's art it is impossible

to disguise them. The tuberculous deposits upon the pleural membrane lining the chest cavity, thus causing the lungs to adhere to the ribs, or along the internal walls of the abdomen, are sufficient evidence to condemn the carcass. Measly pork and beef are also easily detected by the unaided eye; but the parasitic contamination of such meat is often overlooked, and consequently there is a fine opportunity for a tape worm to become initiated in all who may partake of it.

The extent to which the different kinds of diseased meat are liable to be used will depend in a great measure upon the comparative frequency that these infectious maladies occur among the live stock in a given locality; and the more insidious the nature of the disease the greater is the liability of animals being slaughtered that are more or less affected. Hence a brief description of some of the more common forms of suspected meat, with a review of the pathological conditions of the disease in question, will best serve our present purpose, and possibly throw a gleam of sanitary light on this much neglected subject.

CONSUMPTIVE BEEF.

The meat from cattle affected with tuberculosis is not unfrequently seen in American markets, especially in our larger cities, and even in country towns. Yet, owing to the lack of public appreciation of any sanitary police measures to control such traffic, little or no complaint is made when we are served with consumptive beef. Five years ago, after repeated opportunities for observation on this subject, I called your attention to the prevalence of this malignant malady among our dairy stock, that I believed was publicly almost unknown. And I now affirm with renewed assurance in a pathological point of view, that its baneful consequences to our health and happiness from the use of meat and milk are not surpassed in the whole catalogue of contagious affections.

As this disease is comparatively new to the veterinary profession, its clinical history and pathology has not received that attention which the subject now demands. In fact, few are aware to-day of the extent to which this insidious malady prevails, but the rapid strides which it has made and the hold

it has already gained on our stock, observes a veterinary author, renders it one of the most important questions affecting the well-being of the bovine species.*

The contagious nature of tuberculosis, as shown by recent experiments on animals, can no longer be doubted, and it is now conceded by comparative pathologists that the bovine form of this disease is identical with that of man. Consequently there is great liability of its transmission, either by inoculation or ingestion. In fact, it has repeatedly been produced in rabbits, Guinea-pigs, and calves by feeding them with tuberculous matter. And Prof. Gerlack of the Berlin Veterinary School claims,† as the result of his researches, that this disease in cattle is very infectious, that the presence of a specific virus is evident, and that even the flesh of such diseased animals under certain circumstances, and also the milk, possesses infective properties, though to a less degree than the cheesy matter from the lungs.

There is evidently a strong predisposition in neat stock to this disease, and they are more frequently affected than other domestic animals. The temperament and physical confirmation undoubtedly contribute much to its development; for animals of a phlegmatic type, with an attenuated form, long limbs, and narrow chests are usually the first victims of the malady. Breeders should therefore strive to avoid the possibility of transmitting such diseased qualities. It is more frequent in cows than in oxen, and especially those kept in dairies for a length of time. Hence lactation is believed to be a predisposing cause. The condition also in which animals are kept are no small factors. The cold, damp sheds, the dark, underground stables, and other ill-ventilated abodes, as well as the character of the food, all conspire to rekindle those constitutional taints into morbid activity.

That tuberculosis is rapidly on the increase no well-informed veterinarian can deny. It ranks among the few great scourges of the land; and though our losses, thus far, in live stock

* The Four Bovine Scourges, with an Appendix on the Inspection of Meat, etc., by Thomas Walley, M. R. C. V. S., Edinburgh, 1879.

† The Veterinarian, London, March No., 1875.

property have been largely due to other plagues which sweep their victims off in a manner to be seen by all, yet the ravages of this disease can only be realized, as Prof. Walley of Dick's Veterinary College* observes, when we take into account the vast deterioration, the slow but certain decimation of many of our best herds, the destruction of our animal supplies, and also the danger to human life which can no longer be considered chimerical. Still there are many who from want of knowledge on the subject may even despise the pathological significance of this fell destroyer and thus ignore its deadly meaning, but when we see thousands of these tubercular deposits in a single slaughtered animal, we are forced to conclude that the use of such meat can in no way promote our happiness. Thus we have in every form of tubercle an implacable and destructive foe, and, in fact, there is no other morbid product known that is so *protean* in the number of functional derangements to which it may give rise in the animal economy.

If we inquire further into the causes of the increased susceptibility to the infection, as seen more especially in our thorough-bred stock, we shall find that heredity and multiplied consanguinity play no menial part. Any physical weakness which the sire or dam may possess is liable to be transmitted to the immediate progeny, but if one generation escapes, the trouble may appear in the next, in accordance with the well-established principle of atavism. Diseased conditions are also inherited; and I believe that there is no predisposing cause which exercises such a potent influence in the production of tuberculosis as the pernicious system of in-and-in-breeding. Thus from parent to offspring, from one generation to another, we often see the fatal tendency transmitted in unbroken succession, and the more complicated the relationship becomes, the greater is the virulence of the resulting products. In spite, therefore, of the many palpable examples of this broken law, some breeders still pursue, year by year, the suicidal policy of clinging to *one strain*, regardless of the impending consequences. And Prof. James Law of

* See The Four Bovine Scourges, page 143.

Cornell University, when speaking of consanguineous unions says, "That the esteemed qualities have been preserved, strengthened, and increased in this way there can be no doubt, but there can be just as little doubt that any inherited weakness or disease has been often transmitted and even intensified. I could mention particular families in our highest priced breeds in which tuberculosis has become a fixed character." And further on he observes that "excessive weakness and stupidity of the young is another common result of in-breeding."*

In 1865, Prof. Villemin of the Val-de-grace Hospital, Paris, having conceived that human consumption in certain cases might be due to a specific virus introduced into the system, resorted to a series of experiments on animals to test the question. He was the first to demonstrate the contagiousness of tuberculosis by inoculation. Rabbits and Guinea-pigs were selected, and the material employed was from the human lung. Inoculations were made in various parts of the body, but the results were uniform and of a serious character. Many of the creatures died, others, lingering in a depressed state, were killed when well marked tubercular deposits were found in all, especially in the lungs, and with more or less infiltrations in the other organs, thus showing that the disease had been transmitted.

These results which gave him so much renown as a pathologist led him to experiment with tubercular matter from other animals. Desirous, therefore, of testing the nature of the disease in cattle, he inoculated a rabbit with matter from a cow. The animal became emaciated, and in six weeks was destroyed. Its lungs were filled with hard, tubercular masses, and some of them had taken on a cheesy aspect in the center. The other organs of the body were affected in a similar manner as those in the previous experiments. Hence he concludes that bovine phthisis is identical with that of man.

Dr. Villemin has likewise demonstrated that the tuberculous matter produced artificially by inoculation possesses the same power of transmissibility as when the malady arises

* Report of the Am. Public Health Association, New York, 1875, vol. 2, p. 250.

spontaneously,—thus proving conclusively that in tubercle resides a special elaborated virus which does not lose its identity by several removes, the same as small-pox.* This view of the subject is corroborated by the pathological researches of Dr. Lionel Beale of London, the celebrated microscopist, who declares that tubercle is a minute particle of living matter, and if inoculated under favorable circumstances it is almost sure to grow, multiply, and produce other morbid cells like that from which it was derived.† And furthermore, Villemin has always considered tuberculosis a *specific* malady, for he found that a very small wound and an inconsiderable quantity of matter used was a manifest proof that the intensity of the disease is independent of the *quantity* of the matter inoculated, and that the number and extent of the internal lesions have no relations to those at the seat of puncture.

A disease, therefore, that can be transmitted from one animal to another by inoculation and thus an identical virus reproduced is, strictly speaking, *contagious*. But further and more convincing proof on this subject has been furnished by Prof. Chauveau of the Lyons Veterinary School, who for years has been experimentally studying the intimate pathology of the various contagia. The success of these researches has afforded some startling results pertaining to the use of diseased meat. The discovery also that certain rich virulent matter can infect as readily through the digestive organs as by any other channel has given him a world-wide reputation. And his well-designed experiments on cattle, which he instituted in 1868, have settled for ever among comparative pathologists the question of the virulency of tuberculosis.

He purchased four calves the 18th of September, from a locality where this disease was unknown, which upon rigid examination were found to be in fine, healthy condition. The next day he administered an ounce of tubercular matter from an old cow's lung, including the hard and soft varieties, prepared in the form of a drench and given in divided doses. The first one, a year old, began to lose condition in about a

* See *Veterinarian*, for January, 1875.

† The Microscope in Medicine, fourth Ed., Lond., 1878, pp. 329–38.

fortnight, the respirations were quickened, though the appetite remained unimpared. On the 5th of October he gave this calf another dose, but of different and more recent matter, and within a week the symptoms of tuberculosis were apparent. Emaciation proceeded rapidly, the coat became rough and staring, and the animal had occasional fits of coughing, especially after drinking.

The second calf, six months old, had on the fourth day a profuse and fetid diarrhœa, but of short duration, and the animal remained apparently healthy for three weeks. But the characteristic symptoms as in the other case soon appeared, with enlargement of the glands about the throat. The third one of the same age, having shown no signs of disease, was drenched again October 9th with another kind of matter, but this calf longest resisted the action of the virus, and not until the 25th was there any appreciable derangement of health; but from that time, however, the phenomena of tubercular infection ensued with amazing rapidity, and in a week the calf could scarcely be recognized.

At the close of the experiments, November 10th, the miserable aspect of the three infected creatures when contrasted with the thriving condition of the fourth left no doubt in the mind of even the casual observer as to the changes that had taken place. The post mortem examinations revealed a perfect generalized form of tuberculosis, with the local lesion of the bowels, *tabes mesenterica*, shown in a marked degree, some of the glands being as large as a man's fist. The morbid deposits in the chest cavity also were none the less remarkable. The lungs were studded with crude tubercles, some forty in number, varying in size from a pea to a filbert. The bronchial glands were also involved, but the liver, spleen, and kidneys were not affected.

Thus in the space of fifty two days we have three typical examples, nearly uniform in appearance, of the artificial production of this malignant malady through the digestive organs. In presence of these facts, therefore, I trust that all inquirers after the truth of this matter will be forced to conclude with our illustrious pathologist that the virulence and

contagious properties of tuberculosis are now demonstrated beyond a doubt. And the fact that bovine animals have contracted this disease through the agency of the feed gives us an additional source of danger, for creatures confined in the same stable or pasture, and drinking from the same ponds or troughs, are constantly liable to swallow some of this virus in the mucous discharges from the nostrils of their affected comrades. In fact it is never safe to put another animal in the same stall where one has sickened and died of this complaint without thoroughly renovating the apartment. Nor would I allow an affected creature to mingle with the healthy stock about the yard.

The observations of Dr. Grad,* veterinary surgeon at Wasselonne, Alsace, on the spread of this disease by contaminated stalls, are very conclusive. On different occasions owners had informed him that they had lost several animals from consumption *in the same stall*. At first he did not attach much importance to the matter, but one day, when visiting the stables of an extensive farmer in Leinheim, he was informed that annually for the last five years one of the cattle had died of tuberculosis in a certain stall. The last one he had the opportunity of examining, which had been there but ten months, but had all the symptoms of the malady, greatly emaciated, and troubled with a cough. Dr. Grad's attention was strongly aroused at such a state of things, and to test the matter scientifically he was allowed to select an animal for an experiment. Accordingly he chose from another stable a three-year-old heifer, in calf, that was to all appearances perfectly healthy. She was bred on the farm, had never been unwell, never coughed, and none of her progenitors had ever been affected with phthisis. The cow remained quite well until after calving, when a slight cough appeared; but it increased in frequency, emaciation gradually set in, with all of the symptoms of tuberculosis, and in twelve months the creature was a mere shadow of her former self. The evidence therefore in support of this mode of infection Grad could no

* See Fleming's able memoir on the history of these investigations in the 48th and 49th Vols. of *The Veterinarian*.

longer resist, as this was the sixth case that had occurred in this stall. Hence he very naturally inferred that the disease was probably transmitted by the ingestion of tuberculous matter expectorated by the cattle which had previously occupied the place.

The extension of the malady by cohabitation is therefore always liable to occur when animals are so arranged in the stable that the sick and healthy ones can get their heads together, or feed from the same manger. The hay may thus become contaminated, and the infection takes place through the digestive organs. The expired air also is not unfrequently so laden with virulent matter, especially in the advanced stages, that it is not safe for another animal to inhale it. This mode of transmission, which was first suggested by Dr. Morgagni,* more than a hundred years ago, and has found many advocates among physicians and veterinarians, has now been confirmed by the experiments of Dr. Tappeiner of Meran, in causing animals to inhale the fine particles of tubercular matter from the air of a room in which the virus had been evaporated by a steam atomizer. Out of eleven puppies experimented on, ten showed well-marked miliary tubercle in both lungs on being killed within twenty-five to forty days—thus proving that this disease is contagious by the breath.

The relation of bovine tuberculosis to public hygiene was probably first suggested by Prof. Chauveau, who twelve years ago had already indicated the real source of danger from the use of consumptive beef and milk. But no one has done more to promulgate these investigations, or has contributed more to the advancement of veterinary education in this direction, than George Fleming, F. R. C. V. S., inspecting veterinary surgeon to the British army, and the learned editor of the London *Veterinary Journal*, who, by his encyclopedic writings, has now become an acknowledged authority on the subject.† And in a recent editorial,‡ he says, "That the tuberculosis of cattle is a transmissible disease, and can be con-

* Nature and Cause of Diseases. Lond., 1769.

† See his Manual of Veterinary Sanitary Science and Police, in two vols., 8vo, illustrated. Lond., 1875.

‡ *Veterinary Journal*, Dec. 1879.

veyed not only to animals of the same but also to those of other species in various ways, is now an established fact, upon the recognition of which we have for many years insisted; and since we first called attention to it, some of the best pathologists in Europe have furnished additional testimony as to the readiness with which this transmission takes place, not only by inoculation or ingestion, but also, it would appear, by cohabitation of diseased with healthy animals.

Early in 1879, Prof. Colin of the Alfort Veterinary School contributed a series of observations with regard to the communicability of the disorder; several German and Italian authorities have also published their clinical experience in this direction; and lastly we have the celebrated Prof. Orth of Gottingen, furnishing the results of his researches and experiments. All these are only confirmatory of what we have already stated, but this confirmation is not without its value. Dr. Orth's experiments once more demonstrate that the transmission of bovine tuberculosis is possible between different species of animals, and he also points out the complete analogy or rather perhaps identity, which exists between it and the disease in man.

In his experiments, fifteen animals were fed with tuberculous matter from a diseased cow, and nine of those were infected, of which four died. The remaining five becoming extremely emaciated, were killed. On examination nearly all the organs of the body were found involved in tuberculosis. In all the lungs were affected, but the serous and mucous membranes, the lymphatic glands, the liver, spleen, kidneys, and omentum, were infected in different degrees. And consequently the transmissibility of this affection to animals being proved, he insists that its transmission to man is possible.

The meat of animals affected with this disease should not be used, for any organ or texture in which tubercle has been deposited is surely a dangerous article of food. Much will depend, however, upon the severity of the case and extent of the morbid changes that have taken place. Thus, from what is known in relation to the pathology of this virulent malady,

we should at once interdict the sale of consumptive beef and milk, especially in the advanced stages of the disease, when the glandular tissues have become involved. As the commencement of phthisis is often so insidious in the human subject, and so very difficult at times to arrive at the exciting causes, it is to be feared, at least, that one of the sources of its invasion, according to recent experiments, is to be referred to the utilization of the carcass, but more particularly the milk of such diseased cattle, as food.

There is every reason therefore, says Fleming, to prohibit the use of milk from cows affected with tuberculosis, and especially for infants, who mainly rely upon this fluid for their sustenance, and whose powers of absorption are very active. Even if it did not possess infective properties, its deficiency in nitrogenous elements, fat and sugar, and the increased proportion of earthy salts, would alone render it an objectionable article of diet. In fact, it has long been known that it was liable to produce diarrhea and debility in infants; but though many children fed on such milk have died from tuberculosis or a localized type of it in the bowels known as *Tabes mesenterica*, the part probably played by this liquid in its production has rarely been suspected.*

The recent investigations of Prof. Otto Bollinger of the University of Munich, on the artificial production of tuberculosis as induced by the consumption of diseased milk, has thrown additional light on the subject. He claims that the milk of such animals has a pre-eminently contagious influence, and reproduces the disease in other animals experimented on from that point of view. He believes also that such milk, even when boiled, still retains its injurious properties. Further, he maintains that beyond doubt the tuberculosis of the human subject, though not completely identical with that of the cow, is yet strictly analogous to it, and that consequently the wide prevalence of tuberculosis in the native herds, at least 5 per cent. of which are affected, is a standing danger to health of the community. Seeing the enormous mortality from consumption, more especially in towns, Prof.

* Paraphrased from his Sanitary Police, Vol. 2, page 396.

Bollinger believes it to be of the utmost importance to urge upon all classes, and particularly upon farmers, the absolute necessity of taking every possible means of stamping out the disease among cattle. Meanwhile some measure of safety may be secured by the rigid exclusion of all diseased stock from town dairies, a measure which forms a prominent feature in the programme of the recently established Associated Dairy at Munich, where all the cows are constantly kept under skilled veterinary surveillance, and any that may exhibit the least symptom of tuberculosis are at once weeded out.*

Thus we have abundant proof of the noxious condition of consumptive milk. Comparative pathologists are now agreed on this point; but whether the meat of such diseased animals in the early stages possesses the same infectious properties awaits further investigation. New experiments will be required, and should be instituted at once by State authority, to solve this momentous question pertaining to our health and happiness.

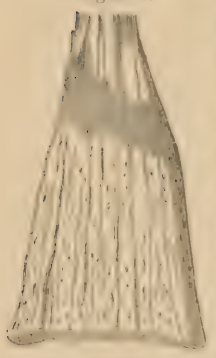
TRICHINOUS PORK.

There is probably no condition of diseased meat more inoffensive in general appearance, and therefore more liable to be overlooked in the culinary process, than the one caused by the presence of minute worms in the flesh of swine. Such meat is exceedingly dangerous as an article of food, and may give rise to one of the most obscure and intractable maladies that the physician has to contend with in human practice. These famous microscopic entozoa that so frequently contaminate our pork, and are known among naturalists as the *Trichina spiralis*, present in their evolution three well-marked stages of existence for us to study, which really anticipate the larva, pupa, and imago phases of development in the winged insects. The natural history of this flesh-worm, therefore, becomes not a little interesting and worthy of special notice in this connection when we endeavor to explain the precise manner of its infection, the phenomena of certain symptoms, and the ultimate cause of death in the human victim.

* *Veterinary Journal*, Feb. 1880.

This parasite was first described and named by Prof. Owen* of London, in 1835, and though frequently seen by scientific observers, it was only regarded as a microscopic curiosity for more than a quarter of a century. His attention had been indirectly called to the subject some two years previously by John Hilton, demonstrator of anatomy at Guy's Hospital Medical College, who had observed a peculiar appearance of human muscle, and thought that it depended upon the formation of very small *cysticerci*. He made a communication to the Medico-chirurgical Society which was deemed worthy of publication, and this is probably the first account we have of the abode of the worm in question.*

Figure 1.



A portion of human muscle showing the cysts of the Trichinæ spiralis, natural size.

Mr. Wormald, the demonstrator at the St. Bartholomew school, had frequently observed the same abnormal and speckled condition of certain muscles. The gritty sensation he had perceived, and the blunting of the edge of his scalpel in dissecting, caused him one day to mention the fact to Prof. Owen. This led to some inquiries concerning the nature of these little calcified bodies in the flesh, and the distinguished anatomist at once requested a specimen for microscopic examination, as seen at Fig. 1, from the next subject he should find thus infected. It was not long before his wish was gratified, but ere he had time to investigate the matter, one of the students, now better known as Sir James Paget, dissected some of the calcareous cysts, and with the aid of a microscope, which he borrowed from Dr. Robert Brown, the well-known botanist, he actually saw the living entozoon first.†

Dr. Vogal in his description of the cyst gave it the appellation of "cocoon," believing that it was formed by the ingenuity of the parasite. Owen found each capsule to contain from one to three small hair-like worms,‡ invariably coiled up,

* Transactions of Zoological Society, Vol. I, page 315.

† See London Medical Gazette, Vol. XI, page 605.

‡ Cyclopedia Anat. and Phys., Vol. II, page 126.

hence he gave it the very appropriate zoological name the parasite now bears. As this examination was made with a low magnifying power, he did not perceive that the little *helminth* had any internal organization; he therefore arranged it among the lowest of the entozoa in his new-made class *Protelmintha*. But Dr. Arthur Farre* by his careful dissections soon distinguished an alimentary canal, which at once elevated the parasite in the classification of naturalists to the order of nematoid worms. Yet he was unable to decide which was the anterior extremity, and for nearly fifteen years there was no advance of anatomical knowledge on the subject. It therefore remained for Prof. H. Luschka of the Tubingen University, in 1850, to point out more accurately the internal structure. He carefully traced the digestive canal, discovered the sexual organs of the female, and conclusively proved that the mouth was situated in the pointed end of the worm, and not in the blunt extremity as was generally believed. He described the cyst in its advanced stages, and demonstrated for the first time a complicated system of blood vessels, and an external membrane of connective tissue by which it is surrounded. In his observations on the vitality of the trichinæ, he found that they survived putrefaction and freezing of the muscles. Dr. Herbst, a German helminthologist, followed in this line of investigation, and his experiments on dogs actually solved the question concerning the propagation of trichinæ. He was the first to rear encapsuled flesh-worms in the muscular tissue, and claimed that in this state only they were transferable from one animal to another.

Dr. Kuchenmeister, having previously shown the transformation of measles or hydatid tæniæ into tape-worms, was led to the supposition that the trichina might be a juvenile form of a known nematode; and after a series of observations, he declared that this flesh-worm was the larva of the *Trichocephalus dispar*.†

A new impulse was given to trichinal investigation in 1859, by Prof. Virchow's experiments. He fed a dog upon trichinous

* London Gazette, Dec., 1835.

† Animal and Vegetable Parasites, Sydenham Ed., Vol. I, page 321.

meat, and in four days found a large number of these nematodes fully developed and sexually mature in the intestines, but he failed to observe the migration of the new-born worms which Herbst had previously demonstrated. This was owing partially to his having killed the dog too early, and also from the fact that he selected an old animal for the experiment, through whose firm tissues the young trichinæ scarcely ever penetrate.

Dr. Zenker of the Dresden Medical School supplemented these observations, and threw much light upon the subject in a medical point of view. He found, upon microscopic examinations, free and living trichinæ in the muscles of a servant girl who died in the hospital, at the age of twenty, of what was supposed to be a typhoid fever. She was taken ill January 12, 1860, and fell a victim to this strange malady within a month. Her symptoms were severe, and in some respect resembled rheumatism, with painful swellings of the limbs. The history of the case, therefore, was of more than usual interest to the profession, and excited not a little clinical inquiry, but no one mistrusted the cause of the trouble. It was soon ascertained, however, after Zenker's post-mortem disclosure, that she had assisted in the making of sausage on the 21st of December previously, and that she had partaken of some of the raw meat only a few days before her illness. This led to his well-known investigation on the nature and pathology of trichinosis, which has been so extensively published to the world, and will ever crown his life with honor. The discovery of this violent parasitic disease in man aroused at once the zeal of professional experts and veterinarians, and was the dawn of a new era in sanitary science.

Prof. R. Leuchart,* of Giessen, followed up the researches on the embryology of the parasite; he made a series of experiments on trichinal infection that were very comprehensive, and did much to advance the science of helminthology. He corrected his own previously expressed opinion on the validity of Kuchenmeister's observation on the transforma-

* For a summary of his views see Burk's translation in Quar. Jour. of Microscopical Science, Vol. VIII, page 168.

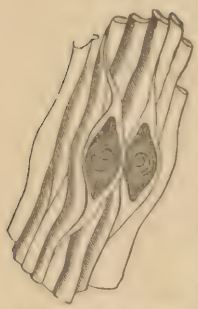
tion of the flesh-worm into trichocephalus, and thus confirmed Virchow. He also showed that the young trichinæ in the intestines became the encysted worm in the muscles, and he believed that they reached there by migration through the tissues, while others claim that the distribution of the trichinæ over the body in so short a time can only be effected through the circulation of the blood.

Dr. Thudichum,* who has made extensive researches on the parasitic diseases of food animals, says, concerning this worm, that the red voluntary muscles are the "promised land" of the trichinæ. There they migrate, grow, and enshrine themselves. Although the young trichinæ, on the seventh day and later after infection, are found in almost all the organs of the body, yet they do not grow or become encapsuled in any other tissue. The trichinæ arrive in the muscular tissue with the blood. The diameter of the smallest capillaries in the muscles is much less than the diameter of the young trichinæ, so they are certain to be arrested. They then penetrate the simple or double coats of the muscles, and are at once in the interstitial spaces between the muscular fibers. Many trichinæ unquestionably never enter the sarcolemma, and become encysted, but when they do the fibers become permanently destroyed. At the end of the third week after immigration, the inflammatory irritation of the muscular fiber has reached its highest point, the trichina is nearly full grown, and becomes fixed to the spot where it is to be encapsuled. Several of these worms may wander in the same track, and ultimately be enclosed in one lump of exuded matter.

It is in the encysted state, as seen at Figure 2, that the trichina is transported from one flesh-eating animal to another. Pigs are not born with these entozoa, but get them in some kind of food, probably from the flesh of rats and mice, and when once swallowed by the hog or other animal, the gastric juice, in the process of digestion, soon dissolves this albuminono-cretaceous cyst, when the parasite will be liberated

* See his able paper on the subject in the 7th Public Health Report of the Privy Council, London, 1865.

Figure 2.



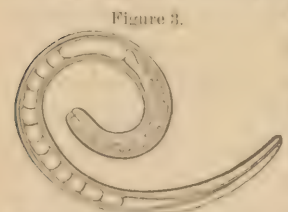
A portion of ham, showing two cysts of the Trichinæ spiralis enclosed, slightly magnified.

from its prison life, and in a few days becomes a full-grown worm.

The sexually mature female, according to Prof. Cobbold,* is one-eighth of an inch in length, while the male is only about two-thirds that size. The female is ovo-viviparous, and thus brings forth its young alive within the stomach and intestines. The young trichinæ begin at once to migrate from the bowels and perambulate the entire system of voluntary muscles; at last they become encased, and there remain for ever at rest, until they perchance shall have been eaten by some other animal, when they in turn will be set free, and thus complete their final destiny.

This parasite, which undoubtedly infects a large number of animals, has frequently been found in the rat, mouse, cat, hedgehog, fox, mole, and hog, and is liable to be transmitted from one carnivorous animal to another through the meat. The Commission of the Royal College of Physicians of Vienna report that the main source of the infection in the hog is from the rat, and nearly one-half of all these vermin examined in Moravia were found infected with the encysted trichinæ; and it is not improbable, as Fleming observes, that the rats were primarily infected and have thus transmitted these parasites from one generation to another by virtue of their carnivorous habit, at times, to devour each other.†

Figure 3.



Trichina magnified one hundred times.

Although the swine of every land may occasionally be infected with this noxious parasite, still the frequency of its transmission will depend in a great measure upon the habits of the people. In those countries where the practice of eating raw pork and sausages so extensively prevails, of course

* See his Entozoa—An introduction to the study of Helminthology, with Supplement, London, 1869.

† Veterinary Sanitary Science.

the parasites contained in the flesh will be transported to the human stomach unmolested, but no fears need be anticipated from even the free use of pork if it has been subjected to a sufficient degree of heat in the process of cooking to destroy every germ of animal life; then it would be as harmless from this cause as fish, beef, or venison.

The ravages of this loathsome malady from the use of diseased pork are not confined to any country, and I believe it prevails more extensively than is generally supposed. Dr. George Sutton of Aurora, Indiana, who has been examining pork killed in the State, says he has found from three to sixteen per cent. of the hogs affected with this disease—differing in various localities—and that, taking the rate at four per cent., we have put upon the market from the Western States 221,484 diseased hogs, or about 44,296,800 pounds of infected meat, every ounce of which might produce disease.* And the Committee of the Chicago Academy of Science has shown that the percentage of swine infected by the trichina in the Western States is greater than in Germany. Still, the disease is of rare occurrence on this side of the Atlantic compared to the old country, and we can ascribe no cause for the greater prevalence of this disease in Germany, except it be the habit of eating their ham or sausage in the raw or uncooked state.

The symptoms of trichinous infections in man will depend largely upon the quantity of diseased meat that has been eaten, and also upon the stage of the malady. At first it is marked by local irritation within the intestinal track, before the worms begin to migrate. This gives rise to nausea, loss of appetite, inflammation of the mucous surface of the bowels, and diarrhœa. Peritonitis may sometimes occur from the perforation of the intestinal walls.

The second stage is characterized by general symptoms, muscular pains, rheumatism, etc., occasioned by the migration of the worms in the various parts of the body. There is great soreness, œdema, and stiffness of the muscles. Lassitude and

* A report on Trichinosis, from the Transactions of the Ind. State Medical Society, 1875.

profuse sweating not unusually occur in severe cases, and in this respect it resembles typhoid fever, for which it has many times been mistaken. This stage commences in about ten days from the first illness, and lasts four or five weeks.

In the third phase of the malady the trichinæ have become encysted, the fever, soreness, and inflammation begin to abate, and the patient is in a fair way to recover. In many cases there is a complete restoration to health again, but often it leaves the system in a very prostrate condition, according to the amount of muscular lesion that has taken place.

Thus our only safety from the use of pork, which is always more or less liable to contain trichinæ in any portion of the country, is thorough *cooking*. Salting and smoking, unless long continued, has but little effect upon the vitality of these parasites. Raw ham or sausage should never be allowed upon a sanitary bill of fare; and even boiled ham, when large and fashionably prepared, as seen in many of our eating saloons to-day, not unfrequently contains these living worms. Hence our lives may be prolonged and our health improved by more attention being given to the domestic duties of the household. Then will all meats be served upon our table in a manner both to nourish and promote our happiness.

MEASLY PORK AND BEEF.

This condition of diseased meat is caused by the presence of a larval form of a tape-worm known as a *scolex* or a *hydatid* in the flesh, thus giving it the spotted appearance of the measles, and consequently this term has been applied to the parasite. There are several points of resemblance between the life-history of the tape-worm and the trichina. The measles are the young entozoa in the encysted state and likewise are received into the stomach with the meat, when they become liberated in the process of digestion and grow into the mature parasite. But tape-worms do not multiply like trichina in the human body. Each one comes from a hydatid measle that has been eaten.

The posterior segments of the tape-worm ripen and fall off, and are known as progottides. Each one is sexually com-

plete, a hermaphrodite, and contains a multitude of mature ova; and when eaten by other animals the eggs, set free in the stomach, readily hatch, and the embryo worms with their six hooklets or spines arranged about the head soon perforate the intestinal walls, enter the blood-vessels, and are transported by the circulation to all parts of the system. Being therefore a foreign body in the flesh, inflammation ensues, and they are soon enclosed by an exudation thrown out for protection, and thus a cyst is formed where they develop into a measle, or the *cysticurcus celulosæ* of early authors.

The larval cestode which infests the measly pork is the sexually undeveloped progeny of the armed tape-worm known as the *Taenia solium* of Linnæus. And while the pork measles have been found in the flesh of other animals, the adult parasite seems to claim no other host than the human intestine. The pork tape-worm is probably the best known and by far the most prevalent. In fact, this intestinal parasite is only too frequently the pork-eater's guest. It is therefore obvious that the measly condition of the flesh of swine is the real source of danger.

Hence the necessity for more precaution on our part in rearing these animals for home use or for the general market. Thus a person harboring a single tape-worm may be the means of contaminating many hogs, for each mature segment cast off contains thousands of eggs ready to hatch when taken into the stomach of other animals. Consequently swine should never be allowed access to privy dwellings nor to compost heaps containing night-soil. Better sanitary regulations are therefore demanded even in the homes of the affluent.

The beef measle when eaten by man develops into the *Taenia mediocanellata*, which Kuchenmeister first described and named.* This tape-worm was looked upon for a long time simply as an unarmed variety, but it is now known to be a distinct species. It is larger than the other and the joints are wider. This parasite occurs among beef-eating people, and is quite common in America and European countries. In fact, it prevails most extensively among the Jews and Mahommedan nations, where pork is not used, thus

* Animal Parasites, Vol. I, page 133.

showing conclusively that the broad, unarmed tape-worm comes from the use of measly beef and veal.*

The same sanitary measures will be required to protect the cattle against this larval infection. Their voracious habits sometimes will cause them to eat strange substances. Cattle should therefore not be permitted to frequent those places where human ordure has been left, or to drink from dead ponds that receive the wash from dwellings, especially when it is known that people in the neighborhood are infested with the beef tape-worm.

Though our staple articles of meat may be affected with these larval parasites, yet thorough cooking renders all such flesh perfectly harmless. Raw pork, veal, and beef are dangerous articles of food unless a microscopic examination has been made to determine the possibility of any parasitic infection. And Prof. T. Spencer Cobbold of the Royal Veterinary College, who by his original researches has contributed so largely to our professional literature on this subject, has announced the discovery of a mutton measle, differing in some respects from those other two: but whether the resulting tape-worm will make its abode in man, and thus render the favorite flesh of sheep a diseased article also for human use, has not been determined.

The mature ova of the *Tænia solium*, when taken into the human body with food or drink, develop into the measle quite as readily as in the hog, and thus our own flesh is liable to become the bearer of these larval parasites, a single one of which may prove fatal. Hence, we should strive to guard against all such possible contingencies.*

BRAXY MUTTON AND BLACKLEG VEAL.

In this type of diseased meat we have a virulent blood poison to deal with which infects the entire carcass; and accordingly all animals dying from an anthrax fever in any form should be condemned. Yet we find that the flesh of braxied sheep is a favorite article with many, and some even

* For further account of these measles see Prof. Verrill's able paper on Internal Parasites, in the Secretary's Report, 1869.

† See supplement to his large work on the Entozoa, 1869, and also his new Manual on the Parasites of Man and Animals, London, 1879.

prefer it to the best dressed mutton in the market, claiming that it is more wholesome and easier of digestion. Such a taste of course must be an acquired one, like that of the epicures who seem to relish their game the best when in a state of decomposition. And some forms of braxy mutton are in a similar condition, being soft and putrid many times as soon as the animal is dead.* Such practice is much to be reprobated says a practical shepherd,† although it is almost universal among those connected with the stock in every district where the disease prevails, and in some places large quantities of hams are salted and dried: and from the amount consumed in certain localities there is no doubt but that it is the cause of many blood poisons among the people.

Instances are not wanting where blackleg veal and other anthrax varieties of flesh have been eaten with impunity. There is evidently a great difference in the intensity of the malady. Sometimes the poison may not be fully elaborated, and consequently the virulency of the meat will be less energetic. Thorough cooking may do much to destroy these infectious properties, yet the extensive alterations that have taken place in the tissues and the rapidity with which putrefaction sets in are sufficient reasons, on sanitary grounds, to absolutely prohibit the use of all such diseased meat.

The nature, history, and symptoms of two very malignant anthrax maladies in cattle—splenic apoplexy and charbon—will be found treated at some length in relation to the diseased meat question in my third report, as State Veterinary Surgeon, on the Diseases of Domestic Animals within your State.‡

THE LUNG PLAGUE.

The question of the wholesomeness of meat from animals affected with pleuro-pneumonia is one of much moment to us to-day, and in view of the increasing prevalence of the malady in this country, it is worthy of our consideration and of our expressed opinions for the public good.

* See Robertson's Prize Essay on Braxy in Transactions of the Highland and Agricultural Society of Scotland, Vol. 19.

† Cowan's Essay on Braxy, in the 18th Vol. of the above transactions.

‡ In the Secretary's Agricultural Report of 1873. See also Fleming's Veterinary Sanitary Science.

Since the first introduction of the lung plague in 1843, the herds of the New England and Middle States have not been free from its local ravages. During its history of thirty-seven years upon our virgin soil, the germs of this contagious malady have become so effectually disseminated along the Atlantic coast that fresh and unexpected outbreaks are now of frequent occurrence, especially in the vicinity of New York, where the disease first made its appearance.

The western movement of our thorough-bred stock of late years has opened new channels for the development of the disease; and unless immediate action is taken by Congress to intercept the impending scourge, these potent germs will ere long be found lurking among the vast herds upon the plains, if not already wafted there by the trend of civilization.

The cattle of your own State for some time past have been more or less affected by this disease, and thrice have we been called upon as a Commission in the last ten years to stay its progress. And still there is more work to be done, which your next Legislature in its wisdom and economy cannot ignore. And should pleuro-pneumonia, the dreaded plague of our land, ever become through political neglect a general epizootic, and thus sweep across the continent decimating our herds upon the hilltops and plains, we are not without a bright sanitary consolation in such an event to cheer the poor and broken-hearted, for the meat from thousands upon thousands of our fine animals that must of necessity fall victims in its march, if slaughtered at an early stage of the malady, could be utilized in a great measure to feed the hungry and needy without a fear of dangerous consequences to the health of our panic-stricken millions.

Thus our great dread of the extension of the lung plague is not on account of any infectious condition of the meat, for millions of those affected animals, according to Fleming, have been consumed as human food in various parts of the world, and no evil results have been known to follow. In Great Britain and France there has been for years a regular trade with the butchers in cattle affected with the contagious form of this disease, and yet the sanitary condition of the people

remains unimpaired. But it is the immense loss to our live stock property that would be entailed by such a calamity.

CONCLUSION.

Of the other maladies which are liable to effect our meat supply, the foot and mouth disease is one that is much to be dreaded. And though the flesh of such affected animals is believed to be harmless, yet the milk, under certain conditions, is a dangerous article of food. But observers are not agreed in relation to the matter. The same is true in regard to hog cholera and several other forms of disease, the pathology of which is not sufficiently well understood to enable us, at the present time, to solve the various sanitary questions here involved.

Hence the necessity for a competent veterinary inspector in every State, whose professional duties to the public have already been outlined, in the consideration of our theme. And as we have seen that our health and happiness is frequently involved in the very meat we eat, such an officer, in watching the development and progress of these infectious maladies among our food-producing animals would thus serve as the true guardian of human welfare.